PROGRAM
facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Advanced Turbines Systems

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ADVANCED TURBINES SYSTEMS SUCCESS

Background

For years gas turbine manufacturers faced a barrier that, for all practical purposes, capped power generating efficiencies. The barrier was heat. Above 2300 degrees F, the scorching heat of combustion gases caused metals in the turbine blades and in other internal components to degrade. Since higher temperatures are the key to higher efficiencies, this effectively limited the generating efficiency at which a turbine power plant could convert fuel into electricity.

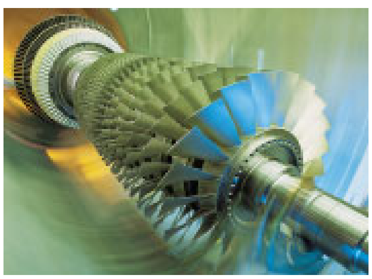
In response, The Advanced Turbine System (ATS) Program was initiated by the U.S. Department of Energy (DOE) in 1992 to produce 21st-century gas turbines - systems that demonstrate increased efficiency and reduced emissions and operating costs. DOE's National Energy Technology Laboratory (NETL) in the Office of Fossil Energy, the Office of Industrial Technologies, and the Office of Energy Efficiency and Renewable Energy shared responsibility with their industrial partners for development of these revolutionary systems.

Two classes of gas turbines were developed under the ATS Program: simple-cycle industrial gas turbines for distributed generation, industrial, and cogeneration markets; and combined-cycle gas turbines for large baseload, central-station, electric power generation markets. The technology was designed for fuel-flexibility, allowing a coal-derived gas or renewable biomass gas in addition to natural gas to be used. Combined-cycle gas turbines became the technology of choice because of the improved system efficiency and lower environmental emissions.

GE's first installation of ATS H System Turbine at Baglan Bay

"BREAKTHROUGH GAS TURBINES"

DOE's Office of Fossil Energy took on the challenge of turbine temperatures in 1992, and nine years later, two of its private sector partners, General Electric (GE) and Siemens Westinghouse, produced breakthrough turbine systems that pushed firing temperatures to 2,600 degrees F and permitted combined cycle efficiencies as high as 60%. Moreover, the advanced turbines achieved the higher firing temperatures while managing to show that the amount of nitrogen oxides formed could be held to less than 10 parts-per-million.



The Future

Natural gas turbine systems, like the *H System* and *G class* combined-cycle turbines are rapidly becoming prime technologies for generating electricity. Within the next ten years, natural gas turbines are expected to provide more than 80% of new power-generating capacity added to the United States power grid.

GE Power Systems H-System

On February 18, 2000, GE Power Systems unveiled the first gas turbine slated for the U.S. market that broke through the temperature barrier and pushed efficiencies to unprecedented levels. The system was designed to work in a "combined cycle" power plant, combining gas and steam turbines to produce electricity.

On June 16, 2003, GE announced that testing of the H System was complete at Baglan Bay in South Wales and the commercial demonstration period was scheduled to begin in September 2003. This combined-cycle turbine burns natural gas and provides electricity/steam to Baglan Energy Park and BP Chemicals' plant. The remaining electricity goes to the U.K. national grid. Testing at Baglan Bay met all of the established performance criteria for this facility.

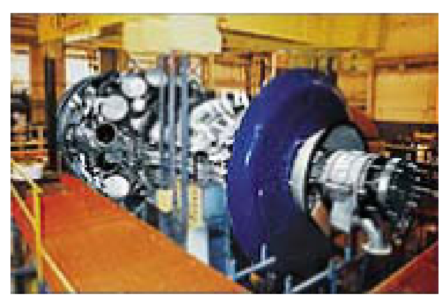
A 60 Hz version of the H System combined cycle turbine is expected to enter commercial service mid-2007 at a facility to be built at Beauharnois, Quebec—southwest of Montreal Canada.

GE has confirmed an order for Tokyo Electric Power Company (TEPCO) to supply three H Systems to Japan in the near future.

GE H Frame Turbine

Westinghouse G-Class

In May 2001, DOE's other advanced turbine development partner, Siemens Westinghouse, announced that its advanced W501G turbine had gone into commercial operation with a 360 MW, combined cycle Millennium power plant in Charlton, Massachusetts. At the time it was the largest 60 Hz gas turbine in the world and among the most efficient, running at approximately 58 percent efficiency in combined-cycle applications. The W501 series incorporates new ATS technologies such as closed-loop steam cooled transition sections, advanced compressor design, and high temperature materials. Currently, Westinghouse has 19 W501G units in operation, and 97 W501F units in operation—all with ATS technology integrated. The turbine is designed to optimize life-cycle costs by balancing capital cost, efficiency and maintenance costs to yield the lowest overall cost of electricity.



Siemens Westinghouse W501G Turbine